

APPENDIX E

**PILOT BALLOON AND RAWINSONDE OBSERVATION
ENCODING AND DECODING**

APPENDIX E
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APPENDIX E

RAWINSONDE AND PILOT BALLOON OBSERVATION ENCODING AND DECODING

E.1 Introduction. Coded messages are used for the international exchange of meteorological information comprising observational data provided by the World Weather Watch (WWW) Global Observing System and processed data provided by the WWW Global Data-processing System. Coded messages are also used for the international exchange of observed and processed data.

The WMO, through its Commission for Basic Systems (CBS), prescribes standard formats for the exchange of meteorological information. These formats (codes) are described in the WMO Manuals on Codes Volumes I and II (WMO No. 306) [Ref. 9]. The United States, as a member of the WMO, uses these codes for the exchange of upper-air data.

Rules concerning the selection of code forms to be exchanged for international purposes, and the selection of their symbolic words, figure groups and letters, are contained in Volume I of the Manual on Codes (issued with separate covers as Volume I.1 -- Part A, and Volume I.2 -- Part B and Part C.)

Apart from the international codes, several sets of regional codes exist which are intended for exchanges only within a specific WMO Region. These codes are contained in Volume II of the Manual on Codes. Volume II also contains descriptions of:

- Regional procedures for the use of international code forms;
- National coding practices in the use of international or regional codes of which the WMO Secretariat has been informed;
- National code forms.

E.2 WMO Code Forms. Each WMO code form is identified by the letters FM followed by a complex term composed of an Arabic numeral followed by a Roman numeral and a short descriptor. The Arabic numeral assigns classes to the various code forms. In general the 10-series pertains to codes related to surface observations. The 20-series pertains to radar observations. The 30-series pertains to upper-air observations involving the tracking of a balloon or sounding device. However, this convention does not continue through the rest of the code-series so should not be relied upon as a hard and fast rule. The sub-classes in each series pertain to specific types of observations within those classes such as 32-PILOT (an upper wind observation); 35-TEMP (a rawinsonde observation from a fixed land station); 36-TEMP SHIP (a rawinsonde observation from a ship); 37-TEMP DROP (a dropsonde observation from an aircraft); and 38-TEMP MOBIL (a rawinsonde observation from a mobile land station). The Roman numeral indicates at which session of the WMO Commission the code was either adopted or last revised. The principal function of the Roman numeral is to enable users to determine if they have the most recently published version of the code.

E.3 Symbolic Forms for Data Groups. The codes are composed of a set of CODE FORMS and BINARY CODES made up of SYMBOLIC LETTERS (or groups of letters) representing meteorological or, as the case may be, other geophysical elements. In messages, these symbolic letters (or groups of letters) are transcribed into figures indicating the value or the state of the elements described. SPECIFICATIONS have been defined for the various symbolic letters to permit their transcription into figures. In some cases, the specification of the symbolic letter is sufficient to permit a direct transcription into figures. In other cases, it requires the use of CODE FIGURES, the specifications of which are given in CODE TABLES. Furthermore, a certain number of SYMBOLIC WORDS and SYMBOLIC FIGURE GROUPS have been developed for use as code names, code words, symbolic prefixes or indicator groups. The number of letters used in the symbolic form (exclusive of subscripts or superscripts) always equals the number of digits that will appear in the numeric form of an actual coded message.

Parts and sections of code forms may have been built up from a number of well-defined components, each comprising a different type of coded information. Components which can be transmitted as termed a separate report are 'parts' and carry special identification groups. Code forms, or their parts, can be divided into sections which may be omitted from the report under certain conditions and therefore carry a symbolic indicator figure or group.

Code form groups in round brackets are drop-out items and may or may not be included, depending on specified conditions. The absence of round brackets means that the group concerned is always included, as determined by international decision; these decisions are indicated in the regulations appearing under each code form.

Unless indicated otherwise, specifications apply to all forms of the Pilot Balloon and Rawinsonde codes. Code Tables, if needed, are referenced at the end of the specification.

E.4 References To Level Coding. The following code forms and tables contain both explicit and implicit references to the three types of levels: standard, mandatory significant, and additional. Standard levels are covered explicitly in paragraphs E-I.2.2 and E-II.2.2. Additional levels are covered explicitly in paragraphs E-I.2.4 and E-II.2.5 and .6. Some of the mandatory significant levels, such as the surface and tropopause, are dealt with explicitly, while the remainder are referred to implicitly in the paragraphs on Additional Levels.

E.5 Basic Code Construction for Formatted Messages

E.5.1 Versions of the PILOT Messages. Messages from fixed land stations which contain only wind data are called PILOT messages. Those transmitted from ships are labelled PILOT SHIP. Those from mobile land stations are PILOT MOBIL. The three versions of the PILOT code are:

- FM 32-IX PILOT, an upper wind report from a land station;
- FM 33-IX PILOT SHIP, an upper wind report from a ship;
- FM 34-IX PILOT MOBIL, an upper wind report from a mobile land station.

A report from a fixed land station which has been assigned a WMO location index number *shall* report in FM 32 PILOT. Temporary land stations, tasked and equipped to take and transmit upper level wind observations, *shall* use FM 34 PILOT MOBIL. There is no provision in any of the upper-level wind codes for reports from an instrument released from an aircraft.

E.5.1.1 PILOT Observations. The relationship of the four parts of the code form and component sections that can be a part of a given part follow:

The code form consists of the following four parts:

<u>Part</u>	<u>Identifier Letters</u>	<u>Isobaric surfaces</u>
	(M _j M _j)	
A	AA	
B	BB	} Up to and including the 100-hPa surface
C	CC	
D	DD	} Above the 100-hPa surface

(Each part can be transmitted separately.)

The code form is divided into the following sections and indicated Parts:

<u>Section number</u>	<u>Indicator figures or symbolic figure groups</u>	<u>Contents</u>	<u>Parts</u>			
			<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
1	--	Identification and position data	X	X	X	X
2	44 or 55	Data for standard isobaric surfaces	X		X	
3	6,7,66,or 77	Data for maximum wind level(s), with altitudes given in pressure units or tens of geopotential meters, and data for vertical wind shear	X		X	
4	8,9(or 1) or 21212	Data for fixed regional levels and/or additional levels, altitudes given either in geopotential units or in pressure units	X		X	
5	51515 52525 59595	} Code groups to be developed regionally	X		X	
6	61616 62626 69696					

E.5.1.2 The full Code Form for PILOT Observations is contained in APPENDIX E-I.

Where possible, sections and parts are combined in the APPENDIX E-1 to minimize largely redundant symbolic letters, definitions, and regulations.

E.5.2 Versions of the TEMP Messages. Each code form is further specified by a character string that describes the code form more succinctly. For example, the rawinsonde coded messages are described as TEMP messages. The three versions of the TEMP code described in this Handbook are:

- FM 35-X Ext. TEMP, an upper level pressure, temperature, humidity and wind report from a land station;
- FM 36-X Ext. TEMP SHIP, an upper level pressure, temperature, humidity and wind report from a sea station;
- FM 38-X Ext. TEMP MOBIL, an upper level pressure, temperature, humidity, and wind report from a mobile land station.

Temporary land stations are established to support special studies or other short-term activities. Short-term activities are usually less than six months in duration.

E.5.2.1 The relationship of the four parts of the code form and component sections that can be a part of a given TEMP message are outlined in the succeeding paragraphs.

The code form consists of the four parts as follows:

Part	Identifier letters (M _j M _j)	Isobaric surfaces
A	AA	} Up to and including the 100-hPa surface
B	BB	
C	CC	} Above the 100-hPa surface
D	DD	

The code form is further divided into the following sections and their associated parts:

<u>Section number</u>	<u>Indicator figures or symbolic figure groups</u>	<u>Contents</u>	<u>Parts</u>		
			<u>A</u>	<u>B C</u>	<u>D</u>
1	--	Identification and position data	X	X	X X
2	--	Data for standard isobaric surfaces	X		X
3	88	Data for tropopause level(s)	X		X
4	66 or 77	Data for maximum wind level(s) and data for vertical wind shear	X		X
5	--	Data for additional levels, with respect to temperature and/or relative humidity		X	X
6	21212	Data for additional levels, with respect to wind		X	X
7	31313	Data on sea-surface temperature and sounding system		X	
8	41414	Cloud data		X	
9	51515 52525 59595	} Code groups developed regionally		X	X
10	61616 62626 69696	} Code groups developed regionally		X	X

E.5.2.2 The full Code Form for TEMP Observations is contained in Appendix E-II. Where possible, sections and parts are combined to minimize largely redundant symbolic letters, definitions, and regulations.

E.6 Numbering System of International Code Tables. When coding a report, symbolic letters or groups are replaced by figures, which specify the value or the state of the corresponding element. In some cases the specification of the symbolic letter (or group of letters) is sufficient to permit a direct transcription into figures, e.g. GG or PPP. In other cases, these figures are obtained by means of special Code Table for each element.

The Code Tables are also used for decoding incoming reports thus making available the information contained therein.

The Code Tables are numbered, each bearing a number consisting of four figures from 0100 up to 5299 and allotted in the alphabetical order of the symbols to which the Code Tables correspond. The attribution of the numbers is done in accordance with the following system:

- (1) The first two figures represent the number of the main letter of the symbol in alphabetical order. Capital letters are given an odd number, and small letters an even number: 01 for A, 02 for a, 03 for B, 04 for b.....51 for Z and 52 for z.
- (2) The last two figures are allocated in accordance with the following scheme:

00 to 01	are reserved for Code Tables corresponding to a symbol composed of one letter only (X or x, for instance);
02 to 30	are reserved for Code Tables corresponding to symbols of the forms X_A to X_Z , x_A to x_Z and derived symbols such as X_{AO} or x_{AO} ;
31 to 60	are reserved for Code Tables corresponding to symbols of the forms X_a to X_z , x_a to x_z and derived symbols such as X_{aO} or x_{aO}
61 to 70	are reserved for Code Tables corresponding to symbols of the forms X_0 to X_n , or x_0 to x_n , n being any number;
71 to 99	are reserved for Code Tables corresponding to symbols of the forms X' , XX , XXX , x' , xx , xxx or any similar forms such as X_bX_b , $X_0X_0X_0$, x_bx_b , $x_0x_0x_0$.

The numbers attributed to the Code Tables for the different elements specific to upper-air observations for PILOT and TEMP observations are provided in Appendix E-III.

Besides the specifications given by the Code Tables in worldwide use, other sets are established for regional use, which are numbered with a three-figure number ranging from 120 to 800, and are given in Ref. 9: Volume II.

APPENDIX E-I

CODE FORM FOR PILOT OBSERVATIONS

E-I.1 CODE FORM: PILOT Parts A, B, C, and D by SECTION NUMBER

Parts A, B, C, and D: SECTION 1 (E-I.2.1)

$M_i M_i M_j M_j$ $D \dots D^{**}$ $YYGGa_4$
 $IIiii^*$
 { or $99L_a L_a L_a$ $Q_c L_o L_o L_o L_o$ $MMMU_{L_a} U_{L_o}^{**}$ $h_0 h_0 h_0 h_0 i_m^{***}$

Parts A and C: SECTION 2 (E-I.2.2)

$44n P_1 P_1$ }
 or
 $55n P_1 P_1$ } $ddfff \ ddfff \ \dots \ \text{etc.}$

Part A and C: SECTION 3 (E-I.2.3)

$77P_m P_m P_m$ }
 or
 $66P_m P_m P_m$ } $d_m d_m f_m f_m f_m \ (4v_b v_b v_a v_a)$

 or
 $7H_m H_m H_m H_m$ }
 or
 $6H_m H_m H_m H_m$ } $d_m d_m f_m f_m f_m \ (4v_b v_b v_a v_a)$
 or
 77999

Parts B and D: SECTION 4 (E-I.2.4)

9
or
8 } $t_n u_1 u_2 u_3$ d d f f f d d f f f d d f f f

.....

9
or
8 } $t_n u_1 u_2 u_3$ d d f f f d d f f f d d f f f

or

21212

$n_0 n_0 P_0 P_0 P_0$ $d_0 d_0 f_0 f_0 f_0$
 $n_1 n_1 P_1 P_1 P_1$ $d_1 d_1 f_1 f_1 f_1$
.....
 $n_n n_n P_n P_n P_n$ $d_n d_n f_n f_n f_n$

Parts B and D: SECTION 5 (E-I.2.5)

51515
52525
.....
59595 } Code groups developed regionally

Parts B and D: SECTION 6 (E-I.2.6)

61616
62626
.....
69696 } Code groups developed nationally.

E-I.2 PILOT Upper Wind Report Code Forms. Requirements for international exchange require Parts A, B, C, and D for the Upper Winds.

NOTE: For exchange within Region IV and inclusion in subregional and regional broadcasts, Parts A and B may be transmitted together or separately, as may Parts C and D.

**CODE FORM: Parts A and B Up to and including the 100-hPa surface
Parts C and D above the 100-hPa surface**

E-I.2.1 SECTION 1 Identification and position data

Symbolic letters and definitions

$M_i M_i M_j M_j$ D...D** YYGGa₄
 { IIIii*
 or
 99L_aL_aL_a Q_cL_oL_oL_oL_o MMMU_{La}U_{Lo}** h₀h₀h₀h₀i_m***

$M_i M_i$ Type of report
 PP = PILOT (FM 32)
 QQ = PILOT SHIP (FM 33)
 EE = PILOT MOBIL (FM 34)

$M_j M_j$ Part of report transmitted
 AA = Part A
 BB = Part B
 CC = Part C
 DD = Part D

* Used in FM 32 only.
 ** Used in FM 33 and FM 34 only.
 *** Used in FM 34 only.

D...D ship or mobile land station--for ship use ships call sign (three or more alphanumeric characters or the identifier SHIP. In the case of mobile land station, the group **shall** be either the radio call-sign of the station if assigned or an identification group assigned for the duration of the activity which the station is supporting. If possible, the mobile station **should** maintain the same identification for the duration.

YY Day of the month (UTC), (01 equals the first day, 02 the second day, etc.) on which the actual time of observation falls. YY **shall** also be used to indicate the unit of wind speed in addition to indicating the day of the month. When wind speeds are given in knots, 50 **shall** be added to YY. When the speed is given in meters per second, YY **shall** not be modified.

**E-I.2.1 SECTION 1 Identification and position data
(Continued)**

Symbolic letters and definitions

GG Actual time of observation to the nearest whole hour UTC. In the case of a PIBAL observation, the actual time of observation is the time at which the balloon is actually released.

a₄ Type of measuring equipment used (Code Table 0265)

IIiii WMO index number assigned to a fixed land station

99L_aL_aL_a Q_cL_oL_oL_o MMMU_{La}U_{Lo} replacement group for IIIiii of the report for a sea station, aircraft, a carrier balloon, or a mobile land station.

99 data on position to follow

L_aL_aL_a latitude in tenths of a degree

Q_c quadrant of the globe (Code Table 3333)

L_oL_oL_oL_o longitude in tenths of a degree

MMM Marsden square number in which station is located at observation time. (Code Table 2590)

U_{La} unit digit of reported latitude

U_{Lo} unit digit of reported longitude

h₀h₀h₀h₀i_m elevation of mobile land station, units of elevation, and elevation accuracy

h₀h₀h₀h₀ elevation if meters or feet as indicated by i_m

i_m indicator for units of elevation and confidence factor of accuracy (Code Table 1845) assigned or an identification group assigned for the duration of the activity which the station is supporting. If possible, the mobile station *should* maintain the same identification for the duration.

APPENDIX E-I.2: PILOT Upper Wind Report Code Forms

CODE FORM: Part A Up to and including the 100-hPa surface and C above the 100-hPa surface

E-I.2.2 SECTION 2 Data for standard isobaric surfaces

44nP₁P₁
 or } ddfff ddfff.....etc.
 55nP₁P₁

Regulations:

Section 2 *shall* contain data, in ascending order with respect to altitude, for the standard isobaric surfaces of 850, 700, 500, 400, 300, 250, 200, 150, and 100 hPa in Part A and for the standard isobaric surfaces of 70, 50, 30, 20, and 10 hPa in Part C.

When pressure measurements are not available, wind data *shall* be reported using geopotential approximations to the standard isobaric surfaces.

All standard isobaric surfaces within the sounding *shall* be represented in Section 2 of the report by either a data group or a group of solidi (////).

Indicator figures 44 *shall* be used when the standard isobaric isobaric surfaces are located by means of pressure equipment. Indicator figures 55 *shall* be used for the reporting of winds at altitudes approximating the standard isobaric surfaces. If the pressure element failed during the ascent, indicator figures 55 *shall* replace the indicator figures 44 for the remaining standard isobaric surfaces to be reported.

In the report, no more than three wind groups *shall* follow a 44nP₁P₁ or 55nP₁P₁ group. The latter groups *shall* therefore be repeated as often as necessary.

Symbolic letters and coding remarks

44 Standard isobaric surfaces located by radiosonde.

55 Winds reported at altitudes approximating the standard isobaric surfaces (Code Table 5300).

n Number of consecutive isobaric surfaces for which wind data are reported, starting with the surface specified by P₁P₁.

P₁P₁ Pressure of the lowest standard isobaric surface, with respect to altitude, for which wind data are reported. The pressure of surfaces up to and including the 100-hPa surface *shall* be reported in tens of hectopascals. Above the 100-hPa surface, pressure *shall* be reported in whole hectopascals.

dd True direction (rounded off to the nearest 5°), in tens of degrees, from which wind is blowing.

fff Wind speed in, in meters per second or knots. When encoding wind direction that has been rounded off to the nearest 5°, the hundreds and tens figures of this rounded direction *shall* be reported by dd and the units figure *shall* be added to the hundreds figure of the wind speed. When wind speeds are in knots, 50 *shall* be added to YY. When speed is given in meters per second, YY *shall* not be modified.

E-I.2.3 SECTION 3 Data for maximum wind level(s), with altitudes given in pressure units or tens of geopotential meters, and data for vertical wind shear.

$77P_m P_m P_m$
 or
 $66P_m P_m P_m$ } $d_m d_m f_m f_m f_m (4v_b v_b v_a v_a)$
 or
 $7H_m H_m H_m H_m$
 or
 $6H_m H_m H_m H_m$ } $d_m d_m f_m f_m f_m (4v_b v_b v_a v_a)$
 or
 77999

Regulations:

For coding purposes, a maximum wind level:

- (a) **Shall** be determined by consideration of the list of significant levels for wind speed, as obtained by means of the relevant recommended or equivalent national method and not by consideration of the original wind-speed curve;
- (b) **Shall** be located above the 500-hPa isobaric surface and **shall** correspond to a speed of more than 30 meters per second.

NOTE: A maximum wind level is defined as a level at which the wind speed is greater than that observed immediately above and below that level.

Symbolic letters and coding remarks

- 77 When a maximum wind occurred within the sounding and its level was determined by means of pressure, this indicator **shall** be used in the first group of Section 3, i.e. $77P_m P_m P_m$.
- 7 When a maximum wind occurred within the sounding and its altitude was expressed in tens of standard geopotential meters, the indicator figure 7 **shall** be used in the first group of Section 3, i.e. $7H_m H_m H_m H_m$.
- 66 When the greatest wind speed observed throughout the sounding occurred at the top of the sounding and the level of the greatest wind was determined by means of pressure, the indicator figures 66 **shall** be used in the first group of Section 3, i.e. $66P_m P_m P_m$.
- 6 When the greatest wind speed observed throughout the sounding occurred at the top of the sounding and the altitude of the greatest wind was expressed in tens of standard geopotential meters, the indicator figure 6 **shall** be used in the first group of Section 3, i.e. $6H_m H_m H_m$.
- 77999 When a maximum wind is not observed or not reported, group 77999 **shall** be reported in lieu of the maximum wind section, i.e. Section 3.
- $P_m P_m P_m$ Pressure at the maximum wind level. (1) The pressure of surfaces up to and including the 100-hPa surface **shall** be reported in whole hPas. Above the 100-hPa surface, pressure **shall** be reported in tenths of a hectopascal.
- $d_m d_m$ True direction (rounded off to the nearest 5°), in tens of degrees, from which maximum wind is blowing.

APPENDIX E-I.2: PILOT Upper Wind Report Code Forms

CODE FORM: Part A Up to and including the 100-hPa surface and Part C above the 100-hPa surface(Continued)

E-I.2.3 SECTION 3 Data for maximum wind level(s), with altitudes given in pressure units or tens of geopotential meters, and data for vertical wind shear (Continued)

Whenever more than one maximum wind level exists, these levels *shall* be reported as follows:

- (a) The level of greatest maximum wind speed *shall* be transmitted first;
- (b) The other levels *shall* be classified in descending order of speed, and be transmitted only if their speed exceeds those of the two adjacent minimal by at least ten meters per second;
- (c) The levels of maximum wind with the same speed *shall* be encoded successively, beginning with the lowest ones;
- (d) Furthermore, the highest level attained by the sounding *shall* be transmitted, provided:
 - (i) It satisfies the criteria set forth in the Regulation 32.2.3.1 above;
 - (ii) It constitutes the level of the greatest speed of the whole sounding.

When more than one level of maximum wind is observed, data for each level *shall* be reported by repeating Section 3.

Symbolic letters and coding remarks (Continued)

- $f_m f_m f_m$ Maximum wind speed in meters per second or knots. (1) When encoding wind direction that has been rounded off to the nearest 5° , the hundreds and tens figures of this rounded direction *shall* be reported by dd and the units figure *shall* be added to the hundreds figure of the wind speed. (2) The day of the month (UTC) *shall* be used to indicate the unit of wind speed in addition to indicating the day of the month. When wind speeds are given in knots, 50 *shall* be added to YY. When wind speed is given in meters per second, YY *shall* not be modified.
- $(4v_b v_b v_a v_a)$ Section containing wind shear. This group *shall* be included only if data for vertical wind shear are computed and required.
- $v_b v_b$ Absolute value of the vector difference between the maximum wind and the wind blowing at 1 km above the level of maximum wind, in units indicated by YY.
- $v_a v_a$ Absolute value of the vector difference between the maximum wind and the wind blowing at 1 km above the level of maximum wind, in units indicated by YY.
- $H_m H_m H_m H_m$ Altitude of the level of maximum wind, in tens of standard geopotential meters.

E-I.2.4 SECTION 4 Data for fixed-additional levels and/or additional levels, with altitudes given either in geopotential units or in pressure units.

9
 or } t_nu₁u₂u₃ ddfff ddfff ddfff
 8

 9
 or } t_nu₁u₂u₃ ddfff ddfff ddfff
 8
 or
 21212 n₀n₀P₀P₀P₀ d₀d₀f₀f₀f₀
 n₁n₁P₁P₁P₁ d₁d₁f₁f₁f₁

 n_nn_nP_nP_nP_n d_nd_nf_nf_nf_n

Regulations:

Additional levels

The reported additional data alone *shall* make it possible to reconstruct the wind profile with sufficient accuracy for practical use. Care *shall* be taken that:

- (a) The direction and speed curves (in function of the log of pressure or altitude) can be reproduced with their prominent characteristics;
- (b) These curves can be reproduced with an accuracy of at least 10⁰ for direction and five meters per second for speed;
- (c) The number of additional levels is kept strictly to a necessary minimum.

NOTE: To satisfy these criteria, the following method of successive approximations is recommended, but other methods of attaining equivalent results may suit some national practices better and may be used:

Symbolic letters and coding remarks

Indicator figures

- 9 The indicator figure 9 *shall* be used when the altitudes of fixed-additional levels and/or additional level are given in units of 300 meters. The figure 9 *shall* be used in Section 4 up to and including the height of 29 700 meters. Above that level, the indicator figure 1 *shall* be used to specify that 30 000 meters be added to the heights indicated by t_nu₁u₂u₃
- 8 The indicator figure 8 *shall* be used in Section 4 when the altitudes of fixed-additional levels and/or additional levels are given in units of 500 meters.
- t_n Tens digit of the altitude, expressed in units of 300 meters or 500 meters, which applies to the following data groups
- u₁ Units digit of the altitude, expressed in units of 300 meters or 500 meters, for the first data group following.
- u₂ Units digit of the altitude, expressed in units of 300 meters or 500 meters, for the second data group following.
- u₃ Units digit of the altitude, expressed in units of 300 meters or 500 meters, for the third data group following.
- dd True direction, (rounded off to the nearest 5⁰), in tens of degrees, from which wind is blowing.
- (1) When encoding wind direction that has been rounded off to the nearest 5⁰, the hundreds and tens figures of this rounded direction *shall* be reported by dd and the units figure *shall* be added to the hundreds figure of the wind speed.

APPENDIX E-I.2: PILOT Upper Wind Report Code Forms

**CODE FORM: Part B up to and including the 100-hPa surface
Part D above the 100-hPa surface**

E-I.2.4 SECTION 4 Data for fixed-additional levels and/or additional levels, with altitudes given either in geopotential units or in pressure units (Continued).

- (1) The surface level and the highest level attained by the sounding constitute the first and the last mandatory significant levels. The deviation from the linearly interpolated values between these two levels is then considered. If no direction deviates by more than 10° and no speed by more than five meters per second, no other significant level need be reported. Whenever one parameter deviates by more than the limit specified in paragraph (b) above, the level of greatest deviation becomes a supplementary significant level for both parameters.

- (2) The additional levels so introduced divide the sounding into two layers. In each separate layer, the deviation from the linearly interpolated values between the base and the top are then considered. The process used in paragraph (1) above is repeated and yields other significant levels. These additional levels in turn modify the layer distribution, and the method is applied again until any level is approximated to the above-mentioned specified values. For the purpose of computational work, it *should* be noted that the values derived from a PILOT report present two different resolutions:
 - (a) Winds at all levels are reported to the resolution of 5° in direction and one meter per second in speed;
 - (b) Any interpolated wind at a level between two levels is implicitly reported to the resolution of ±10° in direction and ±5 meters per second in speed.

In addition to wind data at other levels, altitudes of which *shall* be reported in geopotential units, data at the following levels *shall* be included:

300 m	1200 m	2400 m	3600 m	7500 m
600 m	1800 m	2700 m	4800 m	9000 m
900 m	2100 m	3200 m	6000 m	15000 m

fff Wind speed in meters per second or knots.

- (1) YY *shall* be used to indicate the unit of wind speed in addition to indicating the day of the month. When wind speeds are given in knots, 50 *shall* be added to YY. When the speed is given in meters per second, YY *shall* not be modified.

21212 n₀n₀P₀P₀P₁ d₀d₀f₀f₀
 n₁n₁P₁P₁P₁ d₁d₁f₁f₁

 n_nn_nP_nP_nP_n d_nd_nf_nf_n

21212 Data for significant levels

n₀n₀ Number of level, starting with
 n₁n₁ station level. Station level
 ... *shall* be coded n₀n₀.
 n_nn_n

P₀P₀P₀ Pressure at specified levels.
 P₁P₁P₁ The pressure of the surfaces up
 ... to and including the 100-hPa
 P_nP_nP_n surface *shall* be reported in whole hectopascals. Above the 100-hPa
 surface, pressure *shall* be reported in tenths of a hectopascal.

d₀d₀ True direction (rounded off to the
 d₁d₁ nearest 5°), in tens of degrees, from
 ... which wind is blowing at specified
 d_nd_n levels starting with surface level. (1) When encoding wind direction
 that has been rounded off to the nearest 5°, the hundreds and tens
 figures of this rounded direction *shall* be reported by dd and the units
 figure *shall* be added to the hundreds figure of the wind speed.

E-I.2.4 SECTION 4 Data for fixed-additional levels and/or additional levels, with altitudes given either in geopotential units or in pressure units. (Continued)

Fixed Levels reported in Section 4 *shall* be determined by regional decision.

In Section 4, the data groups for the fixed- and additional levels within the sounding *shall* appear in ascending order with respect to altitude.

To indicate that the first wind group refers to station level, u_1 *shall* be coded/ (solidus), and appropriate values *shall* be reported for t_n , u_2 and u_3 .

Altitudes: The altitudes of fixed- and additional levels *shall* be reported either in geopotential units or in pressure units. Only one of the units *shall* be used in a coded report.

In addition to wind data at significant levels, altitudes of which *shall* be reported in geopotential units, data at the following fixed levels *shall* be included: 18000, 21000, 24000, 27000, 30000, 33000 m and all successive levels at 3000 m, provided they do not coincide with one of the included significant levels.

The altitudes of 30000 m and above *shall* be encoded using units of 500 m, i.e. the altitudes 30000 m and 33000 m shall be included as 8606/, at the altitudes 36000 m and 39000 m as 8728/, etc.

Symbolic letters and coding remarks

$f_0f_0f_0$
 $f_1f_1f_1$
 ...
 $f_nf_nf_n$

Wind speed in meters per second or knots, at specified levels starting with station level.

- (1) When encoding wind direction that has been rounded off to the nearest 5° , the hundreds and tens figures of this rounded direction *shall* be reported by dd and the units figure *shall* be added to the hundreds figure of the wind speed. (2) YY *shall* be used to indicate the unit of wind speed in addition to indicating the day of the month. When wind speeds are given in knots, 50 *shall* be added to YY. When the speed is given in meters per second, YY *shall* not be modified.

APPENDIX E-I.2: PILOT Upper Wind Report Code Forms

CODE FORM: Part B Up to and including the 100-hPa surface and Part D above the 100-hPa surface (Continued)

E-I.2.5 SECTION 5 Code groups developed regionally

51515
52525
.....
59595

} Code groups developed regionally

E-I.2.6 SECTION 6 Code groups developed nationally

61616
62626
.....
69696

} Code groups to be developed nationally

APPENDIX E-II

CODE FORM FOR TEMP RAWINSONDE OBSERVATIONS

E-II.1 CODE FORM: TEMP Parts A and B Up to and including the 100-hPa Surface and Parts C and D Above the 100-hPa Surface

SECTION 1: Parts A, B, C, and D

<u>M_iM_jM_jM_j</u>	D....D** Iiii*	YYGGI _d	
	{ or 99L _a L _a L _a	Q _c L _o L _o L _o L _o	MMMU _{La} U _{Lo} *** h ₀ h ₀ h ₀ h ₀ i _m

SECTION 2: Parts A and C

<u>99P₀P₀P₀</u> <u>P₁P₁h₁h₁h₁</u> <u>P_nP_nh_nh_nh_n</u>	T ₀ T ₀ T _{a0} D ₀ D ₀ T ₁ T ₁ T _{a1} D _n D _n T _n T _n T _{an} D _n D _n	d ₀ d ₀ f ₀ f ₀ f ₀ d ₁ d ₁ f ₁ f ₁ f ₁ d _n d _n f _n f _n f _n
---	--	---

SECTION 3: Parts A and C

<u>88P_tP_tP_t</u> or <u>88999</u>	T _t T _t T _{ar} D _t D _t	d _t d _t f _t f _t f _t
--	---	--

SECTION 4: Parts A and C

<u>77P_mP_mP_m</u> or <u>66P_mP_mP_m</u> or <u>77999</u>	} d _m d _m f _m f _m f _m	(4v _b v _b v _a v _a)
--	--	---

SECTION 5: Parts B and D

n ₀ n ₀ P ₀ P ₀ P ₀ n ₁ n ₁ P ₁ P ₁ P ₁ n _n n _n P _n P _n P _n	T ₀ T ₀ T _{a0} D ₀ D ₀ T ₁ T ₁ T _{a1} D ₁ D ₁ T _n T _n T _{an} D _n D _n
---	--

APPENDIX E-II.1 CODE FORM: TEMP Parts A and B Up to and including the 100-hPa Surface and Parts C and D Above the 100-hPa Surface

CODE FORM: TEMP Parts A and B Up to and including the 100-hPa surface and Parts C and D above the 100-hPa surface

SECTION 6: Part B

21212	$n_0 n_0 P_0 P_0 P_0$	$d_0 d_0 f_0 f_0 f_0$
	$n_1 n_1 P_1 P_1 P_1$	$d_1 d_1 f_1 f_1 f_1$

	$n_n n_n P_n P_n P_n$	$d_n d_n f_n f_n f_n$

SECTION 7: Part B

31313	$s_r r_a s_a s_a$	8GGgg ($9s_n T_w T_w T_w$)
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SECTION 8: Parts B and D

41414	$N_h C_L h C_M C_H$
-------	---------------------

SECTION 9: Parts B and D

51515	}	Code groups developed regionally
52525		
.....		
59595		

SECTION 10: Parts B and D

61616	}	Code groups developed nationally
62626		
.....		
69696		

APPENDIX E-II-2: TEMP Upper-level Pressure, Temperature, Humidity, and Wind Report Code Forms

**CODE FORM: Parts A and B Up to and including the 100-hPa surface
Parts C and D above the 100-hPa surface (Continued)**

E-II.2.1 SECTION 1 Identification and position data

NOTES: (Continued)

- (6) If wind data are available up to and including the 250-hPa level, the wind group relating to the 200 hPa *shall* also be included in the report and codes as */////* except when the 250-hPa level is the highest standard isobaric surface reached by the sounding. The same rule *shall* apply to the 150-hPa level with regard to the 100-hPa level.

Symbolic letters and definitions (Continued)

- IIiii WMO index number assigned to a fixed land station
- 99L_aL_aL_a Q_cL_oL_oL_oL_o MMMU_{La}U_{Lo} replacement group for IIIiii of the report for a sea station, aircraft or a carrier balloon, or a mobile land station.
- 99 data on position to follow
- L_aL_aL_a latitude in tenths of a degree
- Q_c quadrant of the globe (Code Table 3333, WMO No. 306)
- L_oL_oL_oL_o longitude in tenths of a degree
- MMM Marsden square number in which station is located at observation time (Code Table 2590)
- U_{La} unit digit of reported latitude
- U_{Lo} unit digit of reported longitude
- h₀h₀h₀h₀i_m elevation of mobile land station, units of elevation, and elevation accuracy
- h₀h₀h₀h₀ elevation in meters or feet as indicated by i_m
- i_m indicator for units of elevation and confidence factor of accuracy (Code Table 1845) assigned or an identification group assigned for the duration of the activity which the station is supporting. If possible, the mobile station *should* maintain the same identification for the duration.

**E-II.2.1 SECTION 1 Identification and position data
(Continued)**

Symbolic letters and definitions (Continued)

- YY Day of the month (UTC), (01 indicating the 1st day, 02 the 2nd day, etc.) on which the actual time of observation falls. YY *shall* also be used to indicate the unit of wind speed in addition to indicating the day of the month. When wind speeds are given in knots, 50 *shall* be added to YY. When the speed is given in meters per second, YY *shall* not be modified.
- GG Actual time of observation to the nearest whole hour UTC. In the case of upper-air observations, the actual time of observation is the time at which the balloon is actually released.
- I_d Indicator used to specify the hundreds of hectopascals figure (in Part A of TEMP, TEMP SHIP, and TEMP MOBIL reports) or tens of hectopascals figure (in Part C of TEMP, TEMP SHIP, TEMP DROP and Temp MOBIL reports) of the pressure relative to the last standard isobaric surface for which the wind is reported

APPENDIX E-II-2: TEMP Upper-level Pressure, Temperature, Humidity, and Wind Report Code Forms

**CODE FORM: Part A Up to and including the 100-hPa surface
Part C above the 100-hPa surface (Continued)**

E-II.2.2 SECTION 2 Data for standard isobaric surfaces

99P ₀ P ₀ P ₀	T ₀ T ₀ T _{a0} D ₀ D ₀	d ₀ d ₀ f ₀ f ₀
P ₁ P ₁ h ₁ h ₁ h ₁	T ₁ T ₁ T _{a1} D _n D _n	d ₁ d ₁ f ₁ f ₁
.....
P _n P _n h _n h _n h _n	T _n T _n T _{an} D _n D _n	d _n d _n f _n f _n

Regulations:

The data groups for the surface level and the standard isobaric surfaces of 1000, 925, 850, 700, 500, 400, 300, 250, 200, and 100 hPa **shall** appear in Part A in ascending order with respect to altitude.

For Part C the standard isobaric surfaces are 70, 50, 30, 20, 10, 7, 5, 2, and 1 hPa.

When the geopotential of a standard isobaric surface is lower than the altitude of the reporting station, the air temperature-humidity group for that surface **shall** be included. Solids (////) **shall** be reported for these groups. The wind groups for these levels **shall** be included as specified by the value reported for symbol I_d.

When wind data are available for all levels, the wind group **shall** be included for each level as indicated in the symbolic code form. If wind data are not available for all levels, the procedures given below **shall** be followed:

Symbolic letters and definitions

99P₀P₀P₀ T₀T₀T_{a0}D₀D₀ d₀d₀f₀f₀

99 data for the surface level follows

P₀P₀P₀ Pressure from the surface through 100 hPa **shall** be reported to whole hPa. Pressures < 100 hPa, report to tenths of a hPa.

T₀T₀ Tenths and units digits of air temperature not rounded off, in °C at the specified levels starting with station level.

T_{a0} Tenths of degrees temperature **shall** be indicated by means of T_{a0}, T_{a1}, ..., T_{an}

D₀D₀ Dewpoint depression at standard isobaric surfaces or at D₁D₁ significant levels, starting with station level (use WMO Code Table 0777)

I_d Indicator used to specify the pressure relative to the last standard isobaric surface for which a wind is reported (WMO Code Table 1734).

**E-II.2.2 SECTION 2 Data for standard isobaric surfaces
(Continued)**

Symbolic letters and definitions

Regulations: (Continued)

- | | | |
|-----|-----------|---|
| | d_0d_0 | True direction (rounded off to the nearest 5°), in tens of degrees from which the wind is blowing at specified levels starting with surface level |
| (a) | | When wind data are missing for one or more standard isobaric surfaces but are available for other standard isobaric surfaces below and above the level of missing wind data, the wind group(s), i.e. $d_n d_n f_n f_n$, shall be coded by means of solidi (////). |
| (b) | $f_0 f_0$ | Wind speed in knots (or meters per second depending on YY) starting with station level |
| | | When wind data are missing for a standard isobaric surface and are also missing for all succeeding standard isobaric surfaces up to the termination of the ascent, the wind group shall be omitted for all these levels and the symbol I_d reported accordingly. |

Whenever it is desired to extrapolate a sounding for the computation of the geopotential at a standard isobaric surface, the following rules **shall** apply:

- (a) Extrapolation is permissible if, and only if, the pressure difference between the minimum pressure of the sounding and the isobaric surface for which the extrapolated value is being computed does not exceed one quarter of the pressure at which the extrapolated value is desired, provided the extrapolation does not extend through a pressure interval exceeding 25 hPa;
- (b) For the purposes of geopotential calculation, and for this purpose only, the sounding will be extrapolated, using two points only of the sounding curve on a T-log p diagram, namely that at the minimum pressure reached by the sounding and that at the pressure given by the sum of this minimum pressure and the pressure differences, mentioned in (a) above.

**APPENDIX E-II: TEMP Upper-level Pressure, Temperature, Humidity,
and Wind Report Code Forms**

**CODE FORM: Part A Up to and including the 100-hPa surface
Part C above the 100-hPa surface (Continued)**

E-II.2.3 SECTION 3 Data for tropopause level(s)

88P_tP_tP_t T_tT_tT_{at}D_tD_t d_td_tf_tf_tf_t
or
88999

Regulations:

When more than one tropopause is observed, each *shall* be reported by repeating Section 3.

When no tropopause data are observed, the group 88999 *shall* be reported for Section 3.

88P_tP_tP_t T_tT_tT_{at}D_tD_t Data for tropopause levels
or
88999

Symbolic letters and definitions

P_tP_tP_t Pressure at the tropopause levels. The pressures of the level(s) greater than and including the 30 hPa surface *shall* be reported in whole hectopascals.

T_tT_t Air temperature in whole degrees Celsius at the tropopause level. This temperature, measured in degrees and tenths, is not rounded off to the next whole degree; only the whole degrees are indicated by T_tT_t. The tenths of this temperature *shall* be indicated by means of T_{at}.

T_{at} Approximate tenths value and sign (plus or minus) of the air temperature at the tropopause level (Code Table 3931).

88999 When no tropopause data are observed, 88999 *shall* be used for Section 3.

**CODE FORM: Part A Up to and including the 100-hPa surface
Part C above the 100-hPa surface (Continued)**

E-II.2.4 SECTION 4 Data for maximum wind level(s) and data for vertical wind shear

77P_mP_mP_m
or
66P_mP_mP_m
or
77999

} d_md_mf_mf_mf_m (4v_bv_bv_av_a)

Regulations:

When more than one maximum wind level is observed, each **shall** be reported by repeating Section 4.

When no maximum wind level is observed, the group 77999 **shall** be reported by for Section 4.

Indicator figures 77 **shall** be used when the level(s) for which maximum wind data are reported does not coincide with the top of the wind sounding corresponds to the highest wind speed observed throughout the ascent. For the purpose of the above regulation, the "top of the wind sounding" is to be understood as the highest altitude level for which wind data are available.

Group (4v_bv_bv_av_a) **shall** be included only if data for vertical wind shear are computed and required.

Symbolic letters and definitions

77 or 66 Indicator for maximum wind level(s) and wind shear. Indicator figure 77 **shall** be used when the level(s) for which maximum wind data are reported does (do) not coincide with the top of the wind sounding. Indicator figures 66 **shall** be used in the opposite case, i.e. whenever the top of the wind sounding corresponds to the highest wind speed observed throughout the ascent. The top of the wind sounding is to be understood as the highest level for which wind data are available.

P_mP_mP_m Pressure at the maximum wind level. (1) The pressures from the surface including the 100-hPa surface **shall** be reported in whole hPas. For a pressure level less than 100-hPa surface, pressure **shall** be reported in tenths of a hectopascal.

d_md_m True direction (rounded off to the nearest 5°), in tens of degrees, from which maximum wind is blowing.

f_mf_mf_m Maximum wind speed in meters per second or knots. (1) When encoding wind direction that has been rounded off to the nearest 5°, the hundreds and tens figures of this rounded direction **shall** be reported by dd and the units figure **shall** be added to the hundreds figure of the wind speed. (2) The day of the month (UTC) **shall** be used to indicate the unit of wind speed in addition to indicating the day of the month. When wind speeds are given in knots, 50 **shall** be added to YY. When wind speed is given in meters per second, YY **shall** not be modified.

**APPENDIX E-II: TEMP Upper-level Pressure, Temperature, Humidity,
and Wind Report Code Forms**

**CODE FORM: Part A Up to and including the 100-hPa surface
Part C above the 100-hPa surface (Continued)**

**E-II.2.4 SECTION 4 Data for maximum wind level(s) and data and data for
vertical wind shear (Continued)**

Symbolic letters and definitions (Continued)

(4v_bv_bv_av_a) Section containing wind shear.

v_bv_b Absolute value of the vector difference between the maximum wind and the wind 1 km above the level of maximum wind, in units indicated by YY.

v_av_a Absolute value of the vector difference between the maximum wind and the wind 1 km above the level of maximum wind, in units indicated by YY.

77999 When no maximum wind level is observed, the group 77999 *shall* be reported for Section 4.

CODE FORM: Part B Isobaric surfaces up to and including the 100-hPa surface Part D above the 100-hPa surface (Continued)

E-II.2.5 SECTION 5 Data for additional levels, with respect to temperature and/or relative humidity

$n_0 n_0 P_0 P_0 P_0$ $T_0 T_0 T_{a0} D_0 D_0$
 $n_1 n_1 P_1 P_1 P_1$ $T_1 T_1 T_{a1} D_1 D_1$

 $n_n n_n P_n P_n P_n$ $T_n T_n T_{an} D_n D_n$

Regulations:

If, in the determination of additional levels with respect to specified criteria for changes in air temperature and/or relative humidity, the criteria for either variable are satisfied at a particular point in altitude, data for both variables (as available) **shall** be reported for that level.

Dew-point data **shall** be derived using the function (or near equivalent) for the relationship between saturation vapor pressure over water and air temperature (Appendix D, Section D.5.) Dew-point data **shall** not be reported when the air temperature is outside the range stated by WMO for the application of the function; a lesser range may be used as a national practice.

The highest level for which a dew point is reported **shall** be one of the levels selected.

The reported additional levels alone **shall** make it possible to reconstruct the air temperature and humidity profiles within the limits of the criteria specified.

Symbolic letters and definitions

$n_0 n_0 P_0 P_0 P_0$ $T_0 T_0 T_{a0} D_0 D_0$ Data for significant levels, with respect to
 $n_1 n_1 P_1 P_1 P_1$ $T_1 T_1 T_{a1} D_1 D_1$ temperature and/or relative humidity.

 $n_n n_n P_n P_n P_n$ $T_n T_n T_{an} D_n D_n$

$n_0 n_0$ Number of level, starting with
 $n_1 n_1$ station level. Station level **shall** be
 ... coded $n_0 n_0 = 0$
 $n_n n_n$

$P_0 P_0 P_0$ Pressure at specified levels. The
 $P_1 P_1 P_1$ pressure of the surfaces up to and
 ... including the 100-hPa surface **shall**
 $P_n P_n P_n$ be reported in whole hectopascals. Above the 100-hPa surface,
 pressure **shall** be reported in tenths of a hectopascal.

$T_0 T_0$ Tens and units digits of air temperature
 $T_1 T_1$ not rounded off, in degrees Celsius, at
 ... specified levels starting with station
 $T_n T_n$ level.

T_{a0} Approximate tenths value and sign (plus
 T_{a1} or minus) of the air temperature at
 ... specified levels starting with station
 T_{an} level (Code Table 3931).

APPENDIX E-II: TEMP Upper-level Pressure, Temperature, Humidity, and Wind Report Code Forms

CODE FORM: Part B Isobaric surfaces up to and including the 100-hPa surface Part D above the 100-hPa surface (Continued)

E-II.2.5 SECTION 5 Data for mandatory significant levels, with respect to temperature and/or relative humidity

Regulations: (Continued)

Symbolic letters and definitions (Continued)

The following *shall* be included as "mandatory significant levels":

- (a) Surface level and the highest level of the sounding, or aircraft reference level and termination level for descent soundings.
- (b) A level between 110 and 100 hPa;
- (c) Bases and tops of inversions and isothermal layers which are at least 20 hPa thick, provided that the base of the layer occurs below the 300-hPa level or the first tropopause, whichever is the higher;
- (d) Bases and tops of inversion layers which are characterized by a change in temperature of at least 2.5°C or a change in relative humidity of at least 20 percent, provided that the base of the layer occurs below the 300-hPa level or the first tropopause, whichever is the higher;

D₀D₀ Dew-point depression at standard isobaric
D₁D₁ surfaces or at significant levels,
... starting with station level. (Code
D_nD_n table 0777)

Note:

The inversion layers of (c) and (d) may be comprised of several thinner inversion layers separated by thin layers of temperature lapse. To allow for this situation, the tops of the inversion layers or (c) and (d) *shall* each be at a level such that no further inversion layers, whether thick or thin, *shall* occur for at least 20 hPa above the level.

The following *shall* be included as additional levels. They *shall* be selected in the order given, thereby giving priority to representing the temperature profile. As far as possible, these additional levels *shall* be the actual levels at which prominent changes in the lapse rate of air temperature occur:

- (a) Levels which are necessary to ensure that the temperature obtained by linear interpolation (on a T-log P or essentially similar diagram) between adjacent levels *shall* not depart from the observed temperature by more than 1°C below the first level reported above the 300-hPa level or the first tropopause, whichever is the lower, or by more than 2°C thereafter;
- (b) Levels which are necessary to ensure that the relative humidity obtained by linear interpolation between adjacent additional levels *shall* not depart by more than 15 percent from the observed values. (The criterion of 15 percent refers to an amount of relative humidity and not to the percentage of the observed value, e.g. if an observed value is 50 percent, the interpolated value *shall* lie between 35 percent and 65 percent.)

E-II.2.5 SECTION 5 Data for additional levels, with respect to temperature and/or relative humidity (Continued)

Regulations: (Continued)

- (c) Levels which are necessary to limit the interpolation error on diagrams other than T-log P. These levels *shall* be such that the pressure at one significant level divided by the pressure of the preceding significant level *shall* exceed 0.6 for levels up to the first tropopause and *shall* be determined by use of the method for selecting additional levels but with application of tighter criteria.

When an additional level (with respect to air temperature and/or relative humidity) and a standard isobaric surface coincide, data for that level *shall* be reported in Parts A and B (or C and D, as appropriate).

In Part B and D, a layer for which data are missing *shall* be indicated by reporting the boundary levels of the layer and a level of solidi (////) to indicate the layer of missing data, provided that the layer is at least 20 hPa thick. The boundary levels are the levels closest to the bottom and top of the layer for which the observed data are missing. The boundary levels are not required to meet the additional level criteria. The boundary levels and the missing data level groups will be identified by appropriate nn numbers. For example:

33P₃P₃P₃T₃T₃T_{a3}D₃D₃
44////////
55P₅P₅P₅T₅T₅T_{a5}D₅D₅

where the levels 33 and 55 are the boundary levels and 44 indicates the layer for which data are missing.

APPENDIX E-II: TEMP Upper-level Pressure, Temperature, Humidity, and Wind Report Code Forms

**CODE FORM: Part B Isobaric surfaces up to and including the 100-hPa surface
Part D above the 100-hPa surface**

E-II.2.6 SECTION 6 Data for additional levels, with respect to winds

Symbolic letters and definitions

21212 $n_0n_0P_0P_0P_0$ $d_0d_0f_0f_0f_0$
 $n_1n_1P_1P_1P_1$ $d_1d_1f_1f_1f_1$

 $n_n n_n P_n P_n P_n$ $d_n d_n f_n f_n f_n$

21212 $n_0n_0P_0P_0P_1$ $d_0d_0f_0f_0f_0$
 $n_1n_1P_1P_1P_1$ $d_1d_1f_1f_1f_1$
 ...
 $n_n n_n P_n P_n P_n$ $d_n d_n f_n f_n f_n$

Regulation:

Additional levels *shall* be chosen so that the data from them alone *shall* make it possible to reconstruct the wind profile with sufficient accuracy for practical use.

Note: Criteria for determining additional levels with respect to changes in wind speed and direction are given in Regulation 32.3.1.

n_0n_0 Number of level, starting with
 n_1n_1 station level. Station level
 ... *shall* be coded n_0n_0 .
 $n_n n_n$

$P_0P_0P_0$ Pressure at specified levels. Pressure levels from the surface up
 $P_1P_1P_1$ to and including the 100-hPa $P_nP_nP_n$ surface *shall* be reported
 ... in whole hectopascals. For pressures less than 100-hPa surface, pressure
 shall be reported in tenths of a hectopascal.

d_0d_0 True direction (rounded off to the nearest 5°), in tens of degrees, from
 d_1d_1 which wind is blowing at specified levels starting with surface level. (1)
 ... When encoding wind direction that has been rounded off to the nearest
 $d_n d_n$ 5° , the hundreds and tens figures of this rounded direction *shall* be reported
 by dd and the units figure *shall* be added to the hundreds figure of the wind
 speed.

**E-II.2.6 SECTION 6 Data for additional levels, with respect to winds
(Continued)**

Symbolic letters and definitions

$f_0 f_0 f_0$ Wind speed in meters per second or knots,
 $f_1 f_1 f_1$ at specified levels starting with station level
 $f_n f_n f_n$

(1) When encoding wind direction that has been rounded off to the nearest 5°, the hundreds and tens figures of this rounded direction **shall** be reported by dd and the units figure **shall** be added to the hundreds figure of the wind speed. (2) YY **shall** be used to indicate the unit of wind speed in addition to indicating the day of the month. When wind speeds are given in knots, 50 **shall** be added to YY. When the speed is given in meters per second, YY **shall** not be modified.

E-II.2.7 SECTION 7 Data on sea-surface temperature and sounding system

31313 $s_r r_a s_a s_a$ 8GGgg ($9s_n T_w T_w T_w$)

Symbolic letters and definitions

31313 $s_r r_a s_a s_a$ 8GGgg ($9s_n T_w T_w T_w$)

s_r Solar and infrared radiation correction (Code Table 3849).

$r_a r_a$ Radiosonde/sounding system used. (Code Table 3685)

$s_a s_a$ Tracking technique/status of system used. (Code Table 3872)

8 Indicator for Greenwich time

Regulation:

Section 7 is a mandatory section and **shall** always be reported. The group $s_r r_a s_a s_a$ and 8GGgg are mandatory for all TEMP, TEMP SHIP, and TEMP MOBIL. In TEMP SHIP reports, the group $9s_n T_w T_w T_w$ **shall** also be included.

APPENDIX E-ii: TEMP Upper-level Pressure, Temperature, Humidity, and Wind Report Code Forms

**CODE FORM: Part B Isobaric surfaces up to and including the 100-hPa surface
Part D above the 100-hPa surface**

E-II.2.7 SECTION 7 Data on sea-surface temperature and sounding system (Continued) Symbolic letters and definitions (Continued)

GGgg Time of observation, in hours and minutes UTC, the actual time of radiosonde release.

9 Indicator for

s_n Sign of data, and relative humidity indicator (Code Table 3845)

T_wT_wT_w Sea-surface temperature, in tenths of a degree Celsius, its sign being given by s_n.

E-II.2.8 SECTION 8 Cloud data Symbolic letters and definitions

41414 N_hC_LhC_MC_H

41414 N_hC_LhC_MC_H Section 8 Cloud Data

Regulation:

N_h Amount of all the C_L present or, if no C_L is present, the amount of all the C_M cloud present. (WMO Code Table 2700)

C_L Clouds of the genera Stratocumulus, Stratus, Cumulus and Cumulonimbus. (WMO Code Table 0513)

In TEMP, TEMP SHIP, and TEMP MOBIL reports, this section *shall* be used to report cloud data. N_h, h, C_L, C_M, and C_H *shall* be coded in accordance with the regulations in FM 12 SYNOP.

Symbolic letters and definitions (Continued)

- h Height above surface of the base of the lowest cloud seen. (Code Table 1600) (1) the term "height above surface" **shall** be considered as being the height above the official aerodrome elevation or above station level at a non-aerodrome station, or above the surface of the water in reports from ships

- C_M Clouds of the genera Altocumulus, Altostratus, and Nimbostratus. (Code Table 0515) (1) The figure to be reported for C_M **shall** be determined on the basis of the detailed description of C_M clouds and illustrations of them in the International Cloud Atlas in conjunction with specifications in Code Table 0515.

- C_H Clouds of the genera Cirrus, Cirrocumulus and Cirrostratus. (Code Table 0509) (1) The figure to be reported for C_H **shall** be determined on the basis of the detailed description of C_H clouds and illustrations of them in the International Cloud Atlas in conjunction with specifications in Code Table 0509. (2) The figure C_H = 9 **shall** be used when the predominant C_H clouds are Cirrocumulus although small amounts of Cirrocumulus may be present in the C_H cloud system reported under C_H = 1 to 8.

APPENDIX E-II: TEMP Upper-level Pressure, Temperature, Humidity, and Wind Report Code Forms

CODE FORM: Part B Isobaric surfaces up to and including the 100-hPa surface Part D above the 100-hPa surface (Continued)

E-II.2.9 SECTION 9 Code groups developed regionally

Symbolic letters and definitions

WMO Region IV practice calls for additional information for pressure from the surface levels to and including the 100 hPa level *shall* be reported in this section by including supplementary groups.

51515 101A_{df}A_{df}
52525
.....
59595

A_{df}A_{df} Form of additional data reported (Code Table 421)

E-II.2.10 SECTION 10 Code groups developed nationally

Symbolic letters and definitions

61616
62626 Code groups developed nationally
.....
69696

Place holder for Section 10

APPENDIX E-III

REQUIRED CODE TABLES FOR PILOT AND TEMP CODE FORMS

<u>Code Table</u>	<u>Page Number</u>	<u>Indicator</u>	<u>Descriptor</u>
0265	E-38	a ₄	Type of measuring equipment used
0421	E-39	101A _{df} A _{df}	Form of Additional Regional Data
0509	E-43	C _H	Clouds of the genera Cirrus, Cirrocumulus and Cirrostratus
0513	E-44	C _L	Clouds of the genera Stratocumulus, Stratus, Cumulus, and Cumulonimbus
0515	E-45	C _M	Clouds of the genera Altocumulus, Altostratus, and Nimbostratus
0777	E-46	D _t D _t --D _n D _n	Dew-point depression in two figures
1600	E-47	h	Height above the surface at the base of the lowest cloud
1734	E-48	I _d	Indicator used to specify the hundreds of hectopascals figure
1845	E-49	i _m	Indicator for units of elevation, and confidence factor for accuracy of elevation
2582	E-49	M _i M _i M _j M _j	Identification letters of the report; identification letters of the part of the report or the version of the code form
2590	E-50	MMM	Number of Marsden square in which the station is situated at the time of observation
2700	E-54	N	Total cloud cover
3333	E-55	Q _c	Quadrant of the globe
3685	E-56	r _a r _a	Radiosonde/sounding system used
3845	E-58	S _n	Sign of the data, exponent, and reference value
3849	E-58	s _r	Solar and infrared radiation correction
3872	E-59	s _a s _a	Tracking technique/status of system used
3931	E-61	T _a -T _c	Encoding/Decoding the sign and Tenths value of the air temperature
5300	E-62	P _n P _n h _n h _n h _n	Standard heights of isobaric surfaces

Table 0265 (WMO-No. 306, Vol I.1)
a₄ Type of measuring equipment used

Code Figure

- 0 Pressure instrument associated with wind-measuring equipment
- 1 Optical theodolite
- 2 Radiotheodolite
- 3 Radar
- 4 Pressure instrument associated with wind-measuring equipment but pressure element failed during ascent
- 5 VLF-Omega
- 6 Loran-C
- 7 Wind profiler
- 8 Satellite navigation
- 9 Reserved

Table 0421 (WMO-No. 306, Vol II)
101A_{df}A_{df} - Form of Additional Regional Data Reported

<u>Code Figure</u>	<u>Definition</u>
00-31	
00	Not to be allocated
01	First day of month (UTC)
02	Second day of month (UTC)
03	Third day of month (UTC)
04	Fourth day of month (UTC)
05	Fifth day of month (UTC)
06	Sixth day of month (UTC)
07	Seventh day of month (UTC)
08	Eighth day of month (UTC)
09	Ninth day of month (UTC)
10	Tenth day of month (UTC)
11	Eleventh day of month (UTC)
12	Twelfth day of month (UTC)
13	Thirteenth day of month (UTC)
14	Fourteenth day of month (UTC)
15	Fifteenth day of month (UTC)
16	Sixteenth day of month (UTC)
17	Seventeenth day of month (UTC)
18	Eighteenth day of month (UTC)
19	Nineteenth day of month (UTC)
20	Twentieth day of month (UTC)
21	Twenty-first day of month (UTC)
22	Twenty-second day of month (UTC)
23	Twenty-third day of month (UTC)
24	Twenty-fourth day of month (UTC)
25	Twenty-fifth day of month (UTC)
26	Twenty-sixth day of month (UTC)
27	Twenty-seventh day of month (UTC)
28	Twenty-eighth day of month (UTC)
29	Twenty-ninth day of month (UTC)
30	Thirtieth day of month (UTC)
31	Thirty-first day of month (UTC)
32-39	Not allocated
40-59	Reason for no report or an incomplete report
40	Report not filed
41	Incomplete report; full report to follow
42	Ground equipment failure
43	Observation delayed
44	Power failure

Table 0421 (WMO-No. 306, Vol II) (Continued)
101A_{df}A_{df} - Form of Additional Regional Data Reported

<u>Code Figure</u>	<u>Definition</u>
45	Unfavorable weather conditions
46	Low maximum altitude (less than 1500 ft above ground)
47	Leaking balloon
48	Ascent not authorized for this period
49	Alert
50	Ascent did not extend above 400 hPa level
51	Balloon forced down by icing conditions
52	Balloon forced down by precipitation
53	Atmospheric interference
54	Local interference
55	Fading signal*
56	Weak signal*
57	Preventive maintenance
58	Flight equipment failure (transmitter, balloon, attachments, etc.)
59	Any reason not listed above

* Fading signals differ from weak signals in that "fading signals" are first received satisfactorily, then become increasingly weaker, and finally become too weak for reception, while "weak signals" are weak from the beginning of the ascent.

60-64: Miscellaneous

60	Unassigned
61	Unassigned
62	Radiosonde report precedes
63	Unassigned
64	Unassigned

65-69: Doubtful Data

65	Geopotential and temperature data are doubtful between following levels: $0P_n P_n P'_n P'_n$
66	Geopotential data are doubtful between the following levels: $0P_n P_n P'_n P'_n$
67	Temperature data are doubtful between the following levels: $0P_n P_n P'_n P'_n$
68	Dew point depression is missing for reasons other than "motor-boating" between the following levels: $0P_n P_n P'_n P'_n$ (not used when $T_n T_n$ is also missing)
69	Unassigned

70-74 Not allocated

Table 0421 (WMO-No. 306, Vol II) (Continued)
101A_{dr}A_{df} - Form of Additional Regional Data Reported

<u>Code Figure</u>	<u>Definition</u>
75 - 89	Corrected Data
75	Unassigned
76	Unassigned
77	Unassigned
78	Corrected tropopause data section follows
79	Corrected maximum wind section follows
80	Corrected report for the entire report (first* and second* transmissions) precedes
81	Corrected report of the entire first transmission precedes
82	Corrected report of the entire second transmission precedes
83	Corrected data for mandatory levels** follow
84	Corrected data for significant levels** follow
85	Minor error(s) in this report; correction follows
86	Significant level(s) not included in original report follow: //P _n P _n P _n T _n T _n T _{an} D _n D _n or P _n P _n P _n T _n T _n
87	Corrected data for surface follow
88	Corrected additional data groups follow: 101A _{dr} A _{df} etc.
89	Unassigned
90-99	
90	Extrapolated geopotential data follow: P _n P _n h _n h _n h _n (d _n d _n d _n f _n f _n)
91	Extrapolated data precede *
92	Unassigned
93	Unassigned
94	Averaged wind for the surface to 5000 foot MSL layer and the 5000 to 10000 foot MSL layer follow: ddfff ddfff (can be used in the PART A message)
95	Early transmission of 850 and 500 hPa data and stability index follows: 85hhh TTT _a DD ddfff 50hhh TTT _a DD ddfff i _s i _s
96	Early transmission of 850, 700, and 500 hPa data and stability index follow: 85hhh TTT _a DD ddfff 70hhh TTT _a DD ddfff 50hhh TTT _a DD ddfff i _s i _s

Table 0421 (WMO-No. 306, Vol II) (Continued)
101A_{df}A_{df} - Form of Additional Regional Data Reported

<u>Code Figure</u>	<u>Definition</u>
97	Early transmission of 500 hPa data and stability index follows: 50hhh TTT _a DD ddfff i _s i _s
98	Early transmission of 700 hPa data and stability index follows: 70hhh TTT _a DD ddfff i _s i _s
99	Not to be allocated

* Code figure 91 is used only in reports of dropsonde observations.

Unless both the stability index and the mean winds are missing, the Part A message always contains two special 101 groups as follows:

10164	Group that identifies stability index.
10194	Group that identifies the mean winds.

A 5-character group follows the 10164 which contains the encoded stability index. The value that appears in the coded message for the stability index is interpreted as follows:

Coding Stability Index

<u>Code Value</u>	<u>Meaning</u>
00 to 40	Stability index is 0 to 40
51 to 90	Stability index is -1 to -40
91	RH < 20% at either base or 500 hPa level or calculation failed.
92	RH is missing at the base level.

Table 0509 (WMO-No. 306, Vol I.1)
C_HClouds of the genera Cirrus, Cirrocumulus and Cirrostratus

<u>Code figure</u>	<u>Technical specifications</u>	<u>Code figure</u>	<u>Non technical specifications</u>
0	No C _H clouds	0	No Cirrus, Cirrocumulus or Cirrostratus
1	Cirrus fibratus, sometimes uncinus, not progressively invading the sky	1	Cirrus in the form of filaments, strands or hooks, not progressively invading the sky
2	Cirrus spissatus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a Cumulonimbus; or Cirrus castellanus or floccus	2	Dense Cirrus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a Cumulonimbus; or Cirrus with sproutings in the form of small turrets or battlements, or Cirrus having the appearance of cumuliform tufts
3	Cirrus spissatus cumulonimbogenitus	3	Dense Cirrus, often in the form of an anvil, being the remains of the upper parts of Cumulonimbus
4	Cirrus uncinus or fibratus, or both, progressively invading the sky; they generally thicken as a whole	4	Cirrus in the form of hooks or of filaments, or both, progressively invading the sky; they generally become denser as a whole
5	Cirrus (often in bands) and Cirrostratus, or Cirrostratus alone, progressively invading the sky; they generally thicken as a whole, but the continuous veil does not reach 45 degrees above the horizon	5	Cirrus (often in bands converging towards one point or two opposite points of the horizon) and Cirrostratus, or Cirrostratus alone; in either case, they are progressively invading the sky, and generally growing denser as a whole, but the continuous veil does not reach 45 degrees above the horizon
6	Cirrus (often in bands) and Cirrostratus, or Cirrostratus alone, progressively invading the sky; they generally thicken as a whole; the continuous veil extends more than 45 degrees above the horizon, without the sky being totally covered	6	Cirrus (often in bands converging towards one point or two opposite points of the horizon) and Cirrostratus, or Cirrostratus alone; in either case, they are progressively invading the sky, and generally growing denser as a whole; the continuous veil extends more than 45 degrees above the horizon, without the sky being totally covered
7	Cirrostratus covering the whole sky	7	Veil of Cirrostratus covering the celestial dome
8	Cirrostratus not progressively invading the sky and not entirely covering it	8	Cirrostratus not progressively invading the sky and not completely covering the celestial dome
9	Cirrocumulus alone, or Cirrocumulus predominant among the CH clouds	9	Cirrocumulus alone, or Cirrocumulus accompanied by Cirrus or Cirrostratus, or both, but Cirrocumulus is predominant
/	CH clouds invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or because of a continuous layer of lower clouds	/	Cirrus, Cirrocumulus and Cirrostratus invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or more often because of the presence of a continuous layer of lower clouds

Table 0513 (WMO-No. 306, Vol I.1)
C_L Clouds of the genera Stratocumulus, Stratus, Cumulus and Cumulonimbus

<u>Code figure</u>	<u>Technical specifications</u>	<u>Code figure</u>	<u>Non-technical specifications</u>
0	No C _L clouds	0	No Stratocumulus, Stratus, Cumulus or Cumulonimbus
1	Cumulus humilis or Cumulus fractus other than of bad weather,* or both	1	Cumulus with little vertical extent and seemingly flattened, or ragged Cumulus other than of bad weather,* or both
2	Cumulus mediocris or congestus, with or without Cumulus of species fractus or humilis or Stratocumulus, all having their bases at the same level	2	Cumulus of moderate or strong vertical extent, generally with protuberances in the form of domes or towers, either accompanied or not by other Cumulus or by Stratocumulus, all having their bases at the same level
3	Cumulonimbus calvus, with or without Cumulus, Stratocumulus or Stratus	3	Cumulonimbus the summits of which, at least partially, lack sharp outlines, but are neither clearly fibrous (cirriform) nor in the form of an anvil; Cumulus, Stratocumulus or Stratus may also be present
4	Stratocumulus cumulogenitus	4	Stratocumulus formed by the spreading out of Cumulus; Cumulus may also be present
5	Stratocumulus other than Stratocumulus cumulogenitus	5	Stratocumulus not resulting from the spreading out of Cumulus
6	Stratus nebulosus or Stratus fractus other than of bad weather,* or both	6	Stratus in a more or less continuous sheet or layer, or in ragged shreds, or both, but no Stratus fractus of bad weather*
7	Stratus fractus or Cumulus fractus of bad weather,* or both (pannus), usually below Altostratus or Nimbostratus	7	Stratus fractus of bad weather* or Cumulus fractus of bad weather,* or both (pannus), usually below Altostratus or Nimbostratus
8	Cumulus and Stratocumulus other than Stratocumulus cumulogenitus, with bases at different levels	8	Cumulus and Stratocumulus other than that formed from the spreading out of Cumulus; the base of the Cumulus is at a different level from that of the Stratocumulus
9	Cumulonimbus capillatus (often with an anvil), with or without Cumulonimbus calvus, Cumulus, Stratocumulus, Stratus or pannus	9	Cumulonimbus, the upper part of which is clearly fibrous (cirriform), often in the form of an anvil; either accompanied or not by Cumulonimbus without anvil or fibrous upper part, by Cumulus, Stratocumulus, Stratus or pannus
/	CL clouds invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena	/	Stratocumulus, Stratus, Cumulus and Cumulonimbus invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena

* 'Bad weather' denotes the conditions which generally exist during precipitation and a short time before and after.

Table 0515 (WMO-No. 306, Vol I.1)
C_M Clouds of the genera Altostratus, Altostratus and Nimbostratus

<u>Code figure</u>	<u>Technical specifications</u>	<u>Code figure</u>	<u>Non-technical specifications</u>
0	No C _M clouds	0	No Altostratus, Altostratus or Nimbostratus
1	Altostratus translucidus	1	Altostratus, the greater part of which is semi-transparent; through this part the sun or moon may be weakly visible, as through ground glass
2	Altostratus opacus or Nimbostratus	2	Altostratus, the greater part of which is sufficiently dense to hide the sun or moon, or Nimbostratus
3	Altostratus translucidus at a single level	3	Altostratus, the greater part of which is semi-transparent; the various elements of the cloud change only slowly and are all at a single level
4	Patches (often lenticular) of Altostratus translucidus, continually changing and occurring at one or more levels	4	Patches (often in the form of almonds or fish) of Altostratus, the greater part of which is semitransparent; the clouds occur at one or more levels and the elements are continually changing in appearance
5	Altostratus translucidus in bands, or one or more layers of Altostratus translucidus or opacus, progressively invading the sky; these Altostratus clouds generally thicken as a whole	5	Semi-transparent Altostratus in bands, or Altostratus, in one or more fairly continuous layer (semi-transparent or opaque), progressively invading the sky; these Altostratus clouds generally thicken as a whole
6	Altostratus cumulogenitus (or cumulonimbostratus)	6	Altostratus resulting from the spreading out of Cumulus (or Cumulonimbus)
7	Altostratus translucidus or opacus in two or more layers, or Altostratus opacus in a single layer, not progressively invading the sky, or Altostratus with Altostratus or Nimbostratus	7	Altostratus in two or more layers, usually opaque in places, and not progressively invading the sky; or opaque layer of Altostratus, not progressively invading the sky; or Altostratus together with Altostratus or Nimbostratus
8	Altostratus castellanus or floccus	8	Altostratus with sproutings in the form of small towers or battlements, or Altostratus having the appearance of cumuliform tufts
9	Altostratus of a chaotic sky, generally at several levels	9	Altostratus of a chaotic sky, generally at several levels
/	C _M clouds invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or because of continuous layer of lower clouds	/	Altostratus, Altostratus and Nimbostratus invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or more often because of the presence of a continuous layer of lower clouds

Table 0777 (WMO-No. 306, Vol I.1)
D_tD_t--D_nD_n Dew-point depression in two figures

D_tD_t Dew-point depression at the tropopause level

D₀D₀

D₁D₁ Dew-point depression at standard isobaric surfaces or at significant ... levels, starting with station level

D_nD_n

<u>Code</u> <u>figure</u>	<u>Degrees</u> <u>Celsius</u>	<u>Code</u> <u>figure</u>	<u>Degrees</u> <u>Celsius</u>	<u>Code</u> <u>figure</u>	<u>Degrees</u> <u>Celsius</u>	<u>Code</u> <u>figure</u>	<u>Degrees</u> <u>Celsius</u>
00	0.0	25	2.5	50	5	75	25
01	0.1	26	2.6	51	not used	76	26
02	0.2	27	2.7	52	not used	77	27
03	0.3	28	2.8	53	not used	78	28
04	0.4	29	2.9	54	not used	79	29
05	0.5	30	3.0	55	not used	80	30
06	0.6	31	3.1	56	6	81	31
07	0.7	32	3.2	57	7	82	32
08	0.8	33	3.3	58	8	83	33
09	0.9	34	3.4	59	9	84	34
10	1.0	35	3.5	60	10	85	35
11	1.1	36	3.6	61	11	86	36
12	1.2	37	3.7	62	12	87	37
13	1.3	38	3.8	63	13	88	38
14	1.4	39	3.9	64	14	89	39
15	1.5	40	4.0	65	15	90	40
16	1.6	41	4.1	66	16	91	41
17	1.7	42	4.2	67	17	92	42
18	1.8	43	4.3	68	18	93	43
19	1.9	44	4.4	69	19	94	44
20	2.0	45	4.5	70	20	95	45
21	2.1	46	4.6	71	21	96	46
22	2.2	47	4.7	72	22	97	47
23	2.3	48	4.8	73	23	98	48
24	2.4	49	4.9	74	24	99	49

// No humidity data available

Table 1600 (WMO-No. 306, Vol I.1)
h - Height above surface of the base of the lowest cloud seen

Code
Figure

0	0 to 50 m
1	50 to 100 m
2	100 to 200 m
3	200 to 300 m
4	300 to 600 m
5	600 to 1000 m
6	1000 to 1500 m
7	1500 to 2000 m
8	2000 to 2500 m
9	2500 m or more, or no clouds
/	Height of base of cloud not known or base of clouds at a level lower and tops at a level higher than that of the station.

Notes:

- (1) A height of exactly equal to one of the values at the ends of the ranges shall be coded in the higher range, e.g., a height of 600 m shall be reported by code Figure 5.
- (2) Due to the limitation in range of the cloud-sensing equipment used by an automatic station, the code figures reported for h could have one of the three following meanings:
 - (a) The actual height of the base of the cloud is within the range indicated by the code figure; or
 - (b) the height of the base of the cloud is greater than the range indicated by the code figure but cannot be determined due to instrumental limitations; or
 - (c) There are no clouds vertically above the station.

Table 1734 (WMO-No. 306, Vol I.1)

I₄ -Indicator used to specify the hundreds of hectopascals figure (in Part A of TEMP, TEMP SHIP, TEMP DROP and TEMP MOBIL reports) or tens of hectopascals figure (in Part C of TEMP, TEMP SHIP, and TEMP MOBIL reports) of the pressure relative to the last standard isobaric surface for which the wind is reported.

Code

Figure Wind group included up to and including the following standard isobaric surfaces:

	<u>Part A</u>	<u>Part C</u>
1	100 hPa or 150 hPa*	10 hPa
2	200 hPa or 250 hPa**	20 hPa
3	300 hPa	30 hPa
4	400 hPa	---
5	500 hPa	50 hPa
6	---	---
7	700 hPa	70 hPa
8	850 hPa	---
9	925 hPa	---
0	1000 hPa	---
/	No wind group is included for any standard isobaric surface	

* In this case (150 hPa), the wind group relating to the 100-hPa level shall also be included and coded as ///// except when 150 hPa is the highest standard isobaric surface reached by the sounding.

** In this case (250 hPa), the wind group relating to the 200 hPa level shall also be included and coded as ///// except when 250 hPa is the highest standard isobaric surface reached by the sounding.

Table 1845 (WMO-No. 306, Vol I.1)

i_m - Indicator for Units of Elevation and Confidence Factor for Accuracy of Elevation

<u>Code Figure</u>	<u>Units</u>	<u>Confidence Factor</u>
0	Not Used	
1	Meters	Excellent (within 3 meters)
2	Meters	Good (within 10 meters)
3	Meters	Fair (within 20 meters)
4	Meters	Poor (more than 20 meters)
5	Feet	Excellent (within 10 feet)
6	Feet	Good (within 30 feet)
7	Feet	Fair (within 60 feet)
8	Feet	Poor (more than 60 feet)
9	Not Used	

Table 2582 (WMO-No. 306, Vol I.1)

M_iM_i --M_jM_j

M_iM_i Identification letters of the report
M_jM_j Identification letters of the part of the report or the version of the code form

Literal (M_iM_i/M_jM_j) Designators for Data Type and Message Part

<u>Code Type</u>	<u>PART A</u>	<u>PART B</u>	<u>PART C</u>	<u>PART D</u>	<u>RADAT</u>
PILOT	PP	PPAA	PPBB	PPCC	PPDD
PILOT SHIP	QQ	QQAA	QQBB	QQCC	QQDD
PILOT MOBIL	EE	EEAA	EEBB	EECC	EEDD
TEMP	TT TTXX	TTAA	TTBB	TTCC	TTDD
TEMP SHIP	UU UUXX	UUA	UUBB	UUC	UUD
TEMP MOBIL	II IIXX	IIA	IIBB	IIC	IIDD

Table 2590 (WMO number 306, Vol I.1)

MMM - Number of marsden square in which the station is situated at the time of observation.

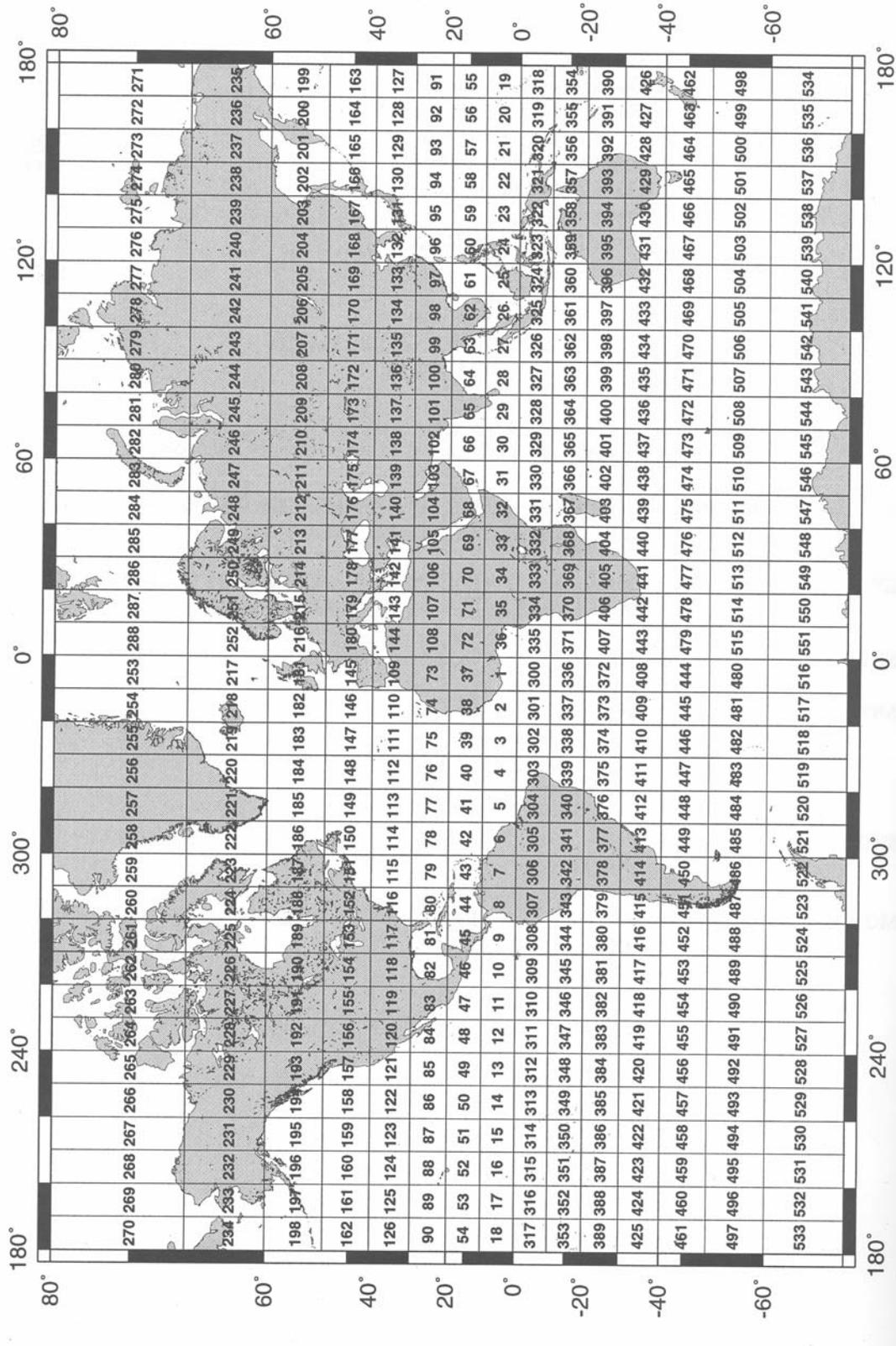


Figure E-1: Assignment of Marsden square numbers

Polar Zones

North of 80° N	910 917 918 919 914 913 912 911 910 909 908 907 906 905 904 903 902 901 900 935 934 933 932 931 930 929 928 927 926 925 924 923 922 921 920 919
	<div style="display: flex; justify-content: space-between; align-items: center; padding: 5px;"> <div style="text-align: left;">←</div> <div style="text-align: center; flex-grow: 1;"> <p style="margin: 0;">West longitudes</p> <p style="margin: 0;">180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180</p> </div> <div style="text-align: right;">→</div> </div> <div style="display: flex; justify-content: space-between; align-items: center; padding: 5px; margin-top: 5px;"> <div style="text-align: right;">←</div> <div style="text-align: center; flex-grow: 1;"> <p style="margin: 0;">East longitudes</p> </div> <div style="text-align: left;">→</div> </div>
70°-80° South	569 568 567 566 565 562 563 562 561 560 559 558 557 556 555 554 553 552 587 586 585 584 583 582 581 580 579 578 577 576 575 574 573 572 571 570
South of 80° S	605 604 603 602 601 600 599 598 597 596 595 594 593 592 591 590 589 588 623 622 621 620 619 618 617 616 615 614 613 612 611 610 609 608 607 606

Figure E-2: Assignment of Marsden Square numbers for polar zones.

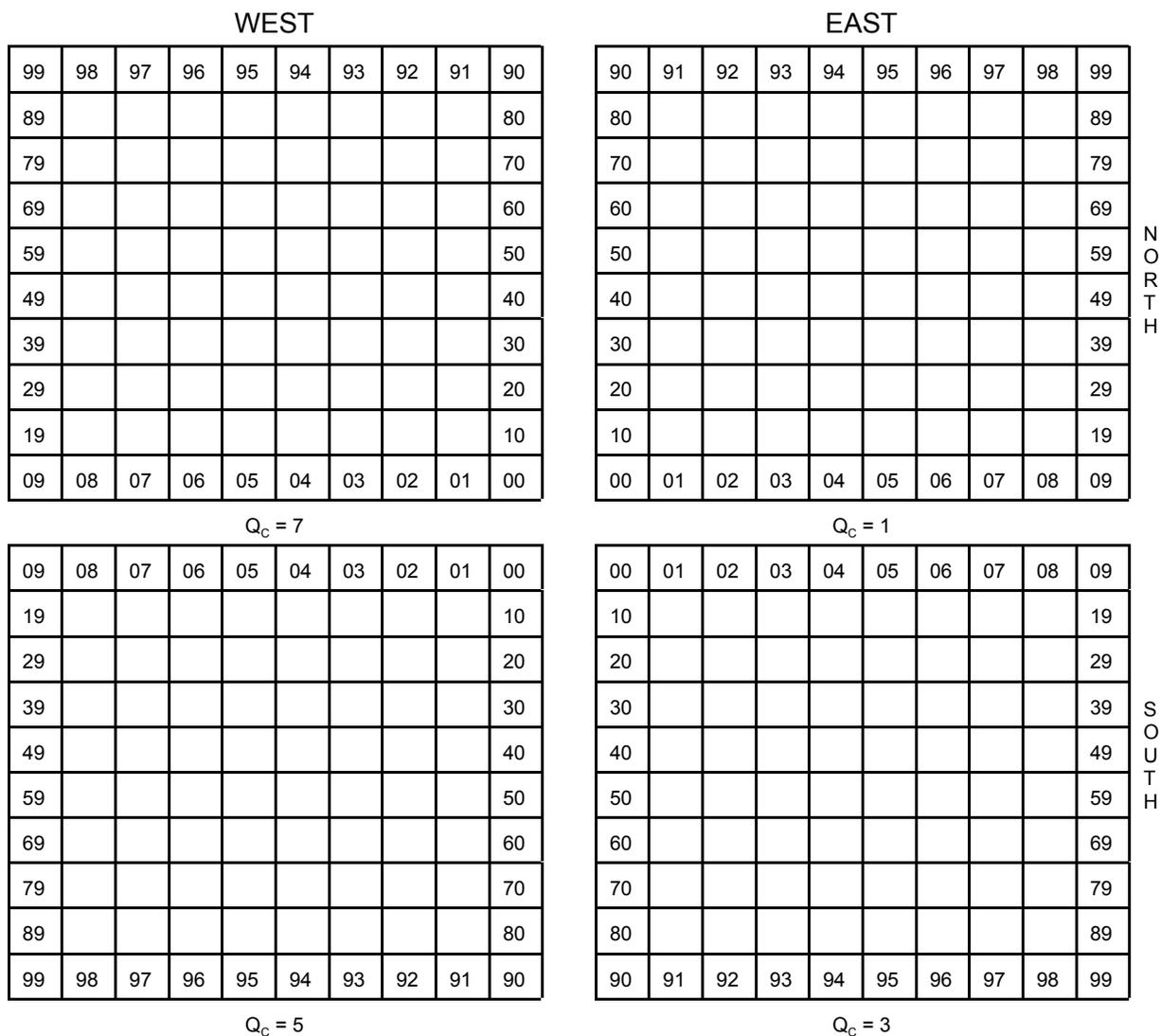


Figure E-3: Subdivisions of the Marsden 10-degree squares into one-degree squares for the eight octants (Q) of the globe.

Note: The number to be coded for $U_{LA}U_{LO}$ in the position verifying group $MMM U_{LA} U_{LO}$ is obtained by combining the second figure for L_a and the third figure for L_o in the reported position ($L_a L_a L_a Q_c L_o L_o L_o$). This number $U_{LA}U_{LO}$ is the number of the one-degree subdivision of the Marsden 10-degree square in which the ship is located at the time of observation.

When the ship is on the boundary between two (or four) 10-degree Marsden squares, the number to be coded for MMM is that of the Marsden 10-degree square for which the one-degree subdivision whose number is $U_{LA}U_{LO}$, as defined above, corresponds to the ship's position.

When the ship is on the meridian 0° or 180° , as well as on the Equator, the number used for reporting Q_C shall be taken into account for determining the relevant number of the Marsden 10-degree square.

Examples:

- (1) For a ship located at 42.3°N and 30.0°W , the position is coded as follows:
 $Q_C = 7, L_aL_aL_a = 423, L_oL_oL_oL_o = 0300$
 $U_{LA}U_{LO}$ is therefore **20**. The ship is on the boundary between Marsden squares 147 and 148. The relevant scheme of the annex ($Q_C = 7$) shows that the one-degree subdivision corresponding to the ship's position would be numbered 29 in Marsden square 147 and **20** in Marsden square 148. MMM is therefore to be coded 148.
- (2) For a ship located at 40.0°S and 120.0°E , the position is coded as follows:
 $Q_C = 3, L_aL_aL_a = 400, L_oL_oL_oL_o = 1200$
 $U_{LA}U_{LO}$ is therefore **00**. The ship is on the boundary point between Marsden squares 431, 432, 467, and 468. The relevant scheme of the annex ($Q_C = 3$) shows that the one-degree subdivision corresponding to the ship's position would be 90 in Marsden square 431, 99 in Marsden square 432, **00** in Marsden square 467, and 09 in Marsden square 468. MMM is therefore coded 467.

Table 2700 (WMO-No. 306, Vol I.1)

- N** Total cloud cover
- N_h** Amount of all the C_L cloud present or, if no C_L cloud is present, the amount of all the C_M cloud present
- N_s** Amount of individual cloud layer or mass whose genus is indicated by C
- N'** Amount of cloud whose base is below the level of the station

Code
figure

0	0	0
1	1 okta or less, but not zero	1/10 or less, but not zero
2	2 oktas	2/10 - 3/10
3	3 oktas	4/10
4	4 oktas	5/10
5	5 oktas	6/10
6	6 oktas	7/10 - 8/10
7	7 oktas or more, but not 8 oktas	9/10 or more, but not 10/10
8	8 oktas	10/10
9	Sky obscured by fog and/or other meteorological phenomena	
/	Cloud cover is indiscernible for reasons other than fog or other meteorological phenomena, or observation is not made	

Note: For use of (/), see WMO Regulation 12.1.4, Ref. 7.

Table 3333 (WMO-No. 306, Vol I.1)
Qc Quadrant of the globe

<u>Code figure</u>	<u>Latitude</u>	<u>Longitude</u>			
1	North	East			
3	South	East	Q _C = 7	N	Q _C = 1
5	South	West			
7	North	West			

Note : The choice is left to the observer in the following cases:

-- When the ship is on the Greenwich meridian or the 180th meridian (L_OL_OL_OL_O = 0000 or 1800 respectively):

Q_C = 1 or 7 (northern hemisphere) or

Q_C = 3 or 5 (southern hemisphere);

-- When the ship is on the Equator (L_aL_aL_a, = 000):

Q_C = 1 or 3 (eastern longitude) or
 Q_C = 5 or 7 (western longitude)

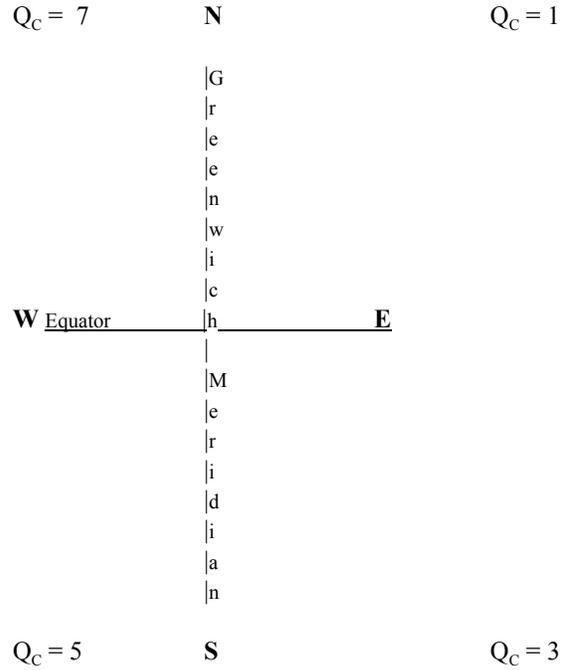


Table 3685 (WMO-No. 306, Vol I.1)
(Table 0 02 011 WMO-No. 306, Vol I Part B)
r_ar_a - Radiosonde/sounding system used

<u>Code Figure</u>	<u>Meaning</u>
00	Reserved
01	Reserved
02	No radiosonde/Passive target (e.g. reflector)
03	No radiosonde/Active target (e.g. transponder)
04	No radiosonde/Passive temperature-humidity profiler
05	No radiosonde/Active temperature-humidity profiler
06	No radiosonde/Radio-acoustic sounder
07	No radiosonde/...)reserved
08	No radiosonde/...)reserved
09	No radiosonde/Sounding system unknown or not specified
10	RS VIZ type A pressure-commutated (USA)
11	RS VIZ type B time-commutated
12	RS SDC (Space Data Corporation - USA)
13	Astor (no longer made - Australia)
14	VIZ MARK I MICROSONDE (USA)
15	EEC Company Type 23 (USA)
16	Elin (Austria)
17	Graw G. (Germany)
18	Reserved for allocation of radiosondes
19	Graw M60 (Germany)
20	Indian Meteorological Service MK3 (India)
21	VIZ/Jin Yang Mark I MICROSONDE (South Korea)
22	Meisei RS2-80 (Japan)
23	Mesural FMO 1950A (France)
24	Mesural FMO 1945A (France)
25	Mesural MH73A (France)
26	Meteolabor Basora (Switzerland)
27	AVK-MRZ (Russian Federation)
28	Meteorite Marz2-1 (Russian Federation)
29	Meteorite Marz2-2 (Russian Federation)
30	Oki RS2-80 (Japan)
31	VIZ/Valcom type A pressure-commutated (Canada)Sangamo
32	Shanghai Radio (China)
33	UK Met Office MK3 (UK)
34	Vinohrady (Czechoslovakia)
35	Vaisala RS18 (Finland)
36	Vaisala RS21 (Finland)
37	Vaisala RS80 (Finland)
38	VIZ LOCATE Loran-C (USA)
39	Sprenger E076 (Germany)
40	Sprenger E084 (Germany)
41	Sprenger E085 (Germany)
42	Sprenger E086 (Germany)
43	AIR IS-4A-1680 (USA)
44	AIR IS-4A-1680 X (USA)
45	RS MSS (USA)

Table 3685 (WMO-No. 306, Vol I.1)
(Table 0 02 011 WMO-No. 306, Vol I Part B) (Continued)
r_ar_a - Radiosonde/sounding system used

46	Air IS-4A-403 (USA)
47	Meisei RS2-91 (Japan)
48	VALCOM (Canada)
49	VIZ MARK II (USA)
50	GRAW DFM-90 (Germany)
51	VIZ B2
52	Vaisala RS80-57
53	Reserved for allocation of radiosondes
54	Reserved for allocation of radiosondes
55	Reserved for allocation of radiosondes
56	Reserved for allocation of radiosondes
57	Reserved for allocation of radiosondes
58	Reserved for allocation of radiosondes
59	Reserved for allocation of radiosondes
60	Vaisala RS80/MicroCora (Finland)
61	Vaisala RS80/DigiCora or Marwin (Finland)
62	Vaisala RS80/PCCora (Finland)
63	Vaisala RS80/Star (Finland)
64	Orbital Sciences Corporation, Space Data Division, transponder radiosonde, type 909-11-XX, where XX corresponds to the model of the instrument (USA)
65	VIZ transponder radiosonde, model number 1499-520 (USA)
66-89	Reserved for additional automated soundings systems
90	Radiosonde not specified or unknown
91	Pressure-only radiosonde
92	Pressure-only radiosonde plus transponder
93	Pressure-only radiosonde plus radar reflector
94	No-pressure radiosonde plus transponder
95	No-pressure radiosonde plus radar reflector
96	Descending radiosonde
97-99	Reserved for allocation of sounding systems with incomplete sondes
100	
...	Reserved BUFR Table 002011 only
...	
254	
255	Missing value

NOTES:

(1) References to countries in brackets indicate the manufacturing location rather than the country using the instrument.

(2) Some of the radiosondes listed are no longer in use but are retained for archiving purposes.

Table 3845 (WMO-No. 306 Vol I.1)

sn	Sign of the data, and relative humidity indicator
sn	Sign of the exponent
sn	Sign of the reference value indicated by rrrrrrr

Code figure

0	Positive or zero
1	Negative
2	Relative humidity follows

Notes:

- (1) Code figures 3 to 8 are not used.
- (2) See WMO Regulation 12.2.3.3.1 for the use of code figure 9.

Table 3849 (WMO-No. 306, Vol I.1)
(Table 0 02 013 WMO-No. 306, Vol I Part B)

s_r - Solar and Infrared Radiation Correction

<u>Code Figure</u>	<u>Meaning</u>
0	No correction
1	CIMO solar corrected and CIMO infrared corrected
2	CIMO solar corrected and infrared corrected
3	CIMO solar corrected only
4	Solar and infrared corrected automatically by radiosonde system
5	Solar corrected automatically by radiosonde system
6	Solar and infrared corrected as specified by country
7	Solar corrected as specified by country
8-14*	Reserved
15*	Missing value

* BUFR Table 0 02 012 only

Table 3872 (WMO-No. 306, Vol I.1)
(Table 0 02 014 WMO-No. 306, Vol I Part B)
s_as_a - Tracking Technique/Status of System Used

Code	
Figure	Meaning
00	No windfinding
01	Automatic with auxiliary optical direction finding
02	Automatic with auxiliary radio direction finding
03	Automatic with auxiliary ranging
04	Not used
05	Automatic with multiple VLF-Omega frequencies
06	Automatic cross chain Loran-C
07	Automatic with auxiliary wind profiler
08	Automatic satellite navigation
09-18	Reserved
19	Tracking technique not specified

Tracking Technique/Status of ASAP System

Status of Ship System

20	Vessel stopped
21	Vessel diverted from original destination
22	Vessel's arrival delayed
23	Container damaged
24	Power failure to container
25-28	Reserved for future use
29	Other problems

Sounding System

30	Major power problems
31	UPS inoperative
32	Receiver hardware problems
33	Receiver software problems
34	Processor hardware problems
35	Processor software problems
36	NAVAID system damaged
37	Shortage of lifting gas
38	Reserved
39	Other problems

Launch Facilities

40	Mechanical defect
41	Material defect (Hand launcher)
42	Power failure
43	Control failure
44	Pneumatic/hydraulic failure
45	Other problems
46	Compressor problems
47	Balloon problems
48	Balloon release problems
49	Launcher damaged

Table 3872 (WMO-No. 306, Vol I.1) (Continued)
(Table 0 02 014 WMO-No. 306, Vol I Part B)
s_as_a - Tracking Technique/Status of System Used

Code Figure	Meaning
Data Acquisition Systems	
50	R/S receiver antenna defect
51	NAVAID antenna defect
52	R/S receiver cabling (antenna) defect
53	NAVAID antenna cabling defect
54-58	Reserved
59	Other problems
Communications	
60	ASAP communications defect
61	Communications facility rejected data
62	No power at transmitting antenna
63	Antenna cable broken
64	Antenna cable defect
65	Message transmitted power below normal
66-68	Reserved
69	Other problems
70	All systems in normal operation
71-98	Reserved
99	Status of system and its components not specified
100-126	Reserved
127	Missing value

Table 3931 (WMO-No. 306, Vol I.1)

T_a -- T_c Encoding/Decoding the Sign and Tenths Value of the Air Temperature in Radiosonde Reports

Code Figures

<u>Tenths Figure of Observed Air Temperature</u>		<u>Positive Temperature</u>	<u>Negative Temperature</u>
0	}	0	1
1			
2	}	2	3
3			
4	}	4	5
5			
6	}	6	7
7			
8	}	8	9
9			

Table 5300 (WMO-No. 306, Vol. I.1)**Standard Heights of Isobaric Surfaces**
(Based on U.S. Standard Atmosphere - 1976)

<u>Standard Surface (hPa)</u>	<u>P_nP_n Coded as</u>	<u>Approximate Height (m)</u>	<u>h_nh_nh_n Coded as</u>
1000	00	100	100
925	92	750	750
850	85	1500	500
700	70	3000	000
500	50	5600	560
400	40	7200	720
300	30	9200	920
250	25	10400	040
200	20	11800	180
150	15	13600	360
100	10	16200	620
70	70	18500	850
50	50	20600	060
30	30	23900	390
20	20	26500	650
10	10	31100	110
7	07	33400	340
5	05	35800	580
3	03	39400	940
2	02	42400	240
1	01	47800	780